REMARKS

Claims 1-7 have been rejected under 35 U.S.C. § 103(a) over Wang et al (US Pat. No. 5,501,266) in view of Asuke (US Pat. No. 5,865,240) and further in view of Kono (US Pat. No. 5,983,976).

Claim 1 recites, among other things, an agitating and injection means disposed within a melting cylinder. The agitating and injection means includes a plurality of agitating wings formed intermittently about an outer periphery of a tip potion of a hollow shaft that extends a length of the melting cylinder. An injection rod is disposed within the hollow shaft and has an injection plunger that extends beyond the tip of the agitating member to insert into the weighing chamber of the injection mechanism with a sliding clearance (see page 7, lines 19-23, of the specification). A sealing ring to prevent reverse flow is provided on the injection plunger (see page 9, lines 12-16, of the specification).

The Examiner asserts that it would have been obvious to modify the apparatus of Wang by adding a concentrically arranged hollow shaft with an interior agitating member (stirrer) with agitating wings as taught by Asuke to draw off a semi-solid metallic material while simultaneously stirring and adjusting the viscosity of the metallic material. Applicants respectfully assert

that there is no teaching to make this modification and, even if such a modification could be made, it would not result in the presently claimed apparatus.

Wang relates to an injection molding machine with a vertical shearing/cooling section. This section includes a solid tubular barrel, a screw within the barrel, a nozzle assembly at a bottom location, and temperature control means for maintaining the barrel at a temperature below the liquidus temperature of the metal. In operation, liquid metal is fed into the shearing/cooling section near the top of the barrel while the screw is in a first, lower position. The liquid metal is sheared by the rotating screw while being cooled below its liquidus temperature under the control of the temperature control means to form a semi-solid material. (Col. 9, lines 23-28) Heating coils and cooling ducts surround the barrel. This arrangement is able to accurately control the temperature of the material to form the semi-solid material by cooling. (Col. 5, lines 21-23, 42 45). The rotating screw is then moved to a second, upper position, and then quickly moved to its first, lower position, thereby ejecting the semi-solid material through the nozzle into the mold. (Col. 9, lines 29-32)

Asuke is cited to teach the provision of a hollow shaft of a concentric arrangement with an agitating member with agitating

wings. Asuke, however, discloses a different type of apparatus intended for a different purpose, namely, continuously removing a semi-solid material having a desired viscosity value from a bath of the semi-solid material. In Asuke, an outer cylinder 24 extends upwardly from a melt tank 2. A screw conveyor 25 attached to a rotatable hollow shaft 16 is located within the cylinder 24 for lifting semi-solid material upwardly out of the melt tank. The inner surface of the cylinder 24 is grooved to allow semi-solid material below a desired viscosity to flow back down into the melt tank. A stirrer 18 is attached to the end of a spindle 17 to provide localized cooling of the material in the melt tank 2. The spindle 17 is arranged within the hollow shaft 16 to provide a coolant channel 21 therebetween for cooling the stirrer blade 18.

The Examiner asserts that the apparatus of Wang could be modified by adding the concentrically arranged hollow shaft with an interior agitating member (stirrer) with agitating wings as taught by Asuke. Claim 1, however, recites a plurality of agitating wings formed intermittently about an outer periphery of a tip portion of the hollow shaft. An injection rod is disposed within the hollow shaft and is extendable beyond the tip of the agitating member into the weighing chamber. In Asuke, the stirrer blade 18 is attached at the end of a solid shaft 17. The solid

shaft 17 is arranged within a hollow shaft 16, the end of which is sealed. Thus, even if Wang could be modified to incorporate this arrangement of Asuke, there would be no provision for an injection rod disposed within the hollow shaft 16 and extendable beyond its end. The interior of the shaft 16 of Asuke is filled with the solid spindle 17 and coolant channel 21, and the end is sealed and blocked by the stirrer 18. Thus, even if Asuke were properly combinable with Wang, the presently recited structure would not result.

Additionally, the asserted motivation to modify Wang with the teachings of Asuke is to draw off a semi-solid metallic material while simultaneously stirring and adjusting the viscosity of the metallic material. There is, however, no need in Wang to draw off a semi-solid material of a desired viscosity. Wang discloses a device for injecting a selected amount of material, accumulated in an accumulation zone, into a mold. Continuously drawing off a portion of this material would not be compatible with the disclosed batch process in which the material is efficiently accumulated and then injected into a mold. Furthermore, when considering Asuke's teachings, such a modification would necessarily entail more than the mere provision of a hollow shaft and stirrer. A substantial reconstruction of Wang's apparatus to

include a melt tank, a conveyor for transporting material upwardly, and grooved channels for allowing some material to return to the melt tank would be necessary. It is unclear how such a reconstruction of Wang's device would be accomplished while still retaining the capability to inject a semi-solid material. Notably, Asuke does not relate to an apparatus for injecting a semi-solid metal, and so Asuke provides no teaching as to how the disclosed continuous separation device could be integrated with a batch injection device such as Wang's. Thus, the asserted motivation to modify Wang to draw off a semi-solid metallic material while simultaneously stirring and adjusting the viscosity thereof is not believed to be applicable to Wang.

Furthermore, the stirrer 18 is intended to effect localized cooling. (Asuke, col. 2, lines 60 61) There is no reason to provide localized cooling in the injection apparatus of Wang. In Wang, all of the accumulated material to be injected must be at the desired temperature. Accordingly, for these reasons, claim 1 and the claims dependent therefrom are believed to be patentable over Wang in view of Asuke.

Claim 1 further recites that the melting cylinder is provided obliquely. Wang discloses an injection molding machine in a vertical arrangement, not an oblique or inclined arrangement. (See

the attached definitions of "incline" and "oblique" from Webster's New World Dictionary.) Wang states: "The vertical-clamping/vertical-injection configuration has been chosen to minimize the gravity effect of metals because it was found that horizontally injected materials sank to the bottom of the die and filled the cavity bottom up, leading to an inertial-effect-dominated flow pattern which will cause a serious asymmetry of the filling and cooling, thus affecting the mechanical properties of the final part." (Col. 3, lines 49-55)

The Examiner states that it would be obvious to modify the apparatus of Wang by using the injection of molten metal in a liquid state at an inclined angle, as taught by Kono, in order to obtain precise control of the injection volume, to reduce the injection cycle time, and to reduce porosity of metal products. Kono, however, relates to an apparatus that is substantially different from that of Wang, such that Kono's teachings are not applicable to Wang. Wang relates to an injection apparatus for semi-solid materials and, as noted above, employs a vertical arrangement to minimize sinking of material in the die cavity. Kono relates to an apparatus for injecting molten material, not semi-solid material, into a mold similar to preplasticization injection molding. Toward this end, Kono discloses a two-chambered

device having a ram in a first inclined chamber and a piston in a second horizontal chamber, with no screw. The melted material is introduced into the second chamber and injected from the second chamber into the mold.

Thus, In Kono, the apparatus has two cylinders, and the metal is both fed and injected in a molten state. In Wang, the metal is changed from liquid to semi-solid, and there is a single shearing/cooling cylinder. Wang further teaches away from an arrangement that is not vertical. Accordingly, Wang and Kono relate to substantially different sorts of apparatuses having different structures and operating parameters.

Furthermore, as a motivation, the Examiner suggests that it would have been obvious to modify the apparatus for injection of a semi-solid material of Wang by using injection of metal in a liquid state as taught by Kono, in order to obtain precise control of injection volume, reduction of injection cycle time, and reduction of porosity of metal products. It is not clear, however, that these advantages are due merely to the provision of inclining the first chamber of Kono, rather than to the entirety of the apparatus of Kono taken as a whole. Accordingly, claim 1 and the claims dependent therefrom are believed to be patentable over Wang in view of Asuke and Kono.

Claims 4, 6, and 7 have been rejected under § 112, second paragraph. Claims 4 and 6 have been amended to address the matters noted by the Examiner, and accordingly, this rejection is believed to be overcome.

Claims 1 and 4 have been objected to for several informalities. These claims have been amended to address the matters noted by the Examiner, and this objection is believed to be overcome.

The specification has been amended at pages 9-10 and 13 to correct obvious errors. The passage at pages 9-10 is amended to correct "molten resin" and "resin" to read "molten metal." The subject of the present invention is an injection molding machine for metallic material. Accordingly, the references to "molten resin" and "resin" are believed to be obvious errors. The passage at page 13 of the specification is describing Fig. 6, which shows a molding process using magnesium. (See page 13, lines 18-19, of the specification). In this context, magnesium is better described as "granular" rather than as "powdered," because powdered magnesium is explosive and cannot be used as a raw material for injection molding. This is an obvious error that arose during translation, and one of skill in the art would recognize both the error and the appropriate correction (i.e., the magnesium should

be granular, not powdered). Accordingly, entry of these amendments to the specification does not involve new matter and is believed to be appropriate.

In view of the above amendments and remarks, Applicants submit that all claims are now in condition for allowance, and reconsideration and indication thereof is respectfully requested. The Examiner is encouraged to telephone the undersigned attorney to discuss any matter that would expedite prosecution of the present application.

Respectfully submitted,

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